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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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Junichi Tanaka

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EXAMINER

KACKAR, RAM N

ART UNIT

PAPER NUMBER

1792

MAIL DATE

DELIVERY MODE

06/10/2008

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/790,212	TANAKA ET AL.	
	Examiner	Art Unit	
	Ram N. Kackar	1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 17 April 2008.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,2,5,6,10,11,14-20 and 23-25 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,2,5,6,10,11,14-20 and 23-25 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>4/17/2008</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 4/17/2008 has been entered.

Claim Rejections - 35 USC § 112

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claims 1-2, 5-6, 10-11, 14-20 and 23-25 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

In this instance in claim 1 the limitation

“amount of edge perimeter undulation of mask sidewalls of the mask, as well as the amount of radicals measured by said plasma monitor, wherein the trimming treatment is carried out for the trimming condition calculated by said trimming condition calculating means;

wherein the edge perimeter undulation amount is calculated on the basis of an aspect ratio of a mask edge perimeter undulation portion and

wherein the edge perimeter undulation amount is calculated on the basis of a Fourier frequency, of the shape of a mask edge perimeter undulation portion” is new matter.

Further in claim 10, the limitation “measured amount of edge perimeter undulation along vertical mask sidewalls, as well as the amount of radicals and the amount of ions measured by said plasma monitor, wherein the trimming treatment is carried out for the trimming condition calculated by said trimming condition calculating means” is also a new matter.

Still further in claim 18, the limitation “pre-measured amount of line edge corrugation extending along vertical mask sidewalls, as well as the amount of radicals and the amount of ions measured by said plasma monitor, wherein the line edge of the vertical mask sidewalls has corrugation consisting of alternating ridges and grooves, and wherein the amount of line edge corrugation is defined as a protrusion amount of ones of the ridges of the line edge divided by a protrusion width of the ones of the ridges of the line edge” is a new matter.

The new matter in these claims is underlined.

Applicants assertion (remarks dated 10/31/2007) that these terms are supported by the specification is not correct.

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 1-2, 5-6, 10-11, 14-20 and 23-25 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In this instance the limitation “pre-measured amount of line edge corrugation extending along vertical mask sidewalls, as well as the amount of radicals and the amount of ions measured by said plasma monitor, wherein the line edge of the vertical mask sidewalls has corrugation consisting of alternating ridges and grooves, and wherein the amount of line edge corrugation is defined as a protrusion amount of ones of the ridges of the line edge divided by a protrusion width of the ones of the ridges of the line edge” is not only a new matter but is indefinite and not understood.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. **Claims 1-2, 5-6, 10-11, 14-20 and 23-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kagoshima et al (US Pub 2003/0003607) in view of an Article “ Modeling the impact of photoresist trim etch process on photoresist surface roughness” by Shahid Rauf et al.**

Kagoshima et al disclose an etching apparatus for etching of mask features (Fig 1 and Abstract) with plasma and a plasma monitor (3) which could be an optical emission spectroscopy (OES) or quadrupole mass spectrometer (QMS) to monitor the species in the plasma (species of plasma contain ions and radicals which react with the substrate to do etching – Paragraph 27 and 44). Kagoshima teaches optimum recipe calculation model which depends upon the monitored result from the plasma monitor (24) and the measurement of CD (22).

Kagoshima et al fail to disclose the roughness parameter of the resist and its inclusion in the recipe calculation model.

Shahid Rauf et al have extensively studied dependence of etch rate upon roughness (undulation or corrugation) when all other factors remain same. They teach that the etch rate is high at the beginning if the initial roughness is high, and reduces when the roughness is reduced. So that it is essential to know the initial roughness in order to estimate etch time needed to etch to target CD. Shahid Rauf et al teach that the roughness factor (RF) is measured as in Fig 1 by R profile of the roughness part and the spatial frequency computed using Fourier transform (Page 656 Col 2). Since the roughness parameter is correlated to etch rate just like RF Power, gas flow, gas pressure and plasma density etc are correlated to it, its inclusion in the recipe calculation model would not only be obvious but essential. Further since etch rate is correlated to roughness and reduction of roughness is faster in the beginning of an etch (Fig 4) the time to etch to a target CD is affected by the initial roughness.

Therefore it would have been obvious for one of ordinary skill in the art at the time of invention to provide to the optimum recipe calculation model of Kagoshima et al, not only the

monitored result of the plasma monitor and the measured CD, but the initial roughness (RF) of the mask in order to deal with the effect of roughness on recipe time.

Regarding 11, this is an intended use claim.

Regarding claim 18 trimming condition calculating means is provided by the model, which includes the initial roughness parameter, which is calculated in the claimed way by Shahid Rauf et al.

Regarding claim 19, Shahid Rauf et al teach that due to roughness the protrusions (positive roughness) get etched faster compared to indentations (negative roughness) so that in the beginning etch process will mainly etch protrusions and roughness will reduce. Therefore total trim time will compose of roughness etch time and regular trim time.

Response to Arguments

Applicant's arguments filed 4/17/2008 have been fully considered but they are not persuasive.

While discrediting Shahid Rauf Applicant repeats the argument that "the two-dimensional model considered in the article will not apply to this type of roughness".

Further applicant elaborates this argument with **“Point 1 and Point 2 sheets”**

Applicant argues that according to Rauf the **results of the Rauf article** will not apply to **general roughness**.

In response, it is not understood what is meant by **“results of the Rauf article”** and **“general roughness”**.

Applicant continues to mischaracterize the relevant teaching of the article.

One of ordinary skill in the art could reasonably infer from Rauf article that to estimate time for etching a CD to a certain width, not only average width but its edge roughness is also required. Since, for a fixed average width, etch rate is highly correlated to roughness. Even if we agree that the correlation (model) will be different for different type of roughness, it can not be denied that for creating a robust model both initial width and edge roughness parameters are needed. Having understood that etch rate is correlated to edge roughness in addition to average width, it is straightforward to create an appropriate model for the kind of roughness at hand (vertical striations or three dimensional).

Rouf points out that three dimensional roughness is more common. It is not clear from the disclosure that the roughness in the claimed invention is exclusively of the type of vertical striations. Further, even if it were so, it would only mean that the appropriate model will have to be different. One of ordinary skill could not infer from the article that in that situation edge roughness parameter would be irrelevant to estimation of etch rate.

It would at least be "obvious to try". A simple experiment would confirm of the existence of a correlation.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ram N. Kackar whose telephone number is 571 272 1436. The examiner can normally be reached on M-F 8:00 A.M to 5:P.M.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Parviz Hassanzadeh can be reached on 571 272 1435. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Ram N Kackar/
Primary Examiner, Art Unit 1792